LOCAL AND MIGRATORY MOVEMENTS OF THE AMERICAN ROBIN IN EASTERN NORTH AMERICA

BY

JOHN MURRAY SPEIRS

B.A., University of Toronto, 1931

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AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ZOOLOGY IN THE GRADUATE SCHOOL OF THE UNIVERSITY OF ILLINOIS, 1946

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ACKNOWLEDGMENTS

The writer wishes to thank Professor J. R. Dymond and Mr. L. L. Snyder of the Royal Ontario Museum of Zoology for their encouragement in the preliminary stages of this investigation. Dr. S. Charles Kendeigh has been unfailingly helpful, and the writer is deeply grateful to him for his constructive suggestions and careful reading of the manuscript.

The writer's wife has contributed greatly by her unfailing assistance, encouragement, and inspiration. Dr. Joseph C. Howell kindly loaned his manuscript dealing with the life history of the robin and assisted in other ways. Mr. Frederick C. Lincoln kindly gave access to the banding records of robins in the files of the Fish and Wildlife Service. The generous assistance of Mr. E. J. Koestner in various aspects of the work is greatly appreciated.

The writer also wishes to express his sincere appreciation for the cooperation of the large number of ornithologists who have helped to make this study possible by supplying data which were often obtained by a great deal of careful work.

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LOCAL AND MIGRATORY MOVEMENTS OF THE AMERICAN ROBIN IN EASTERN NORTH AMERICA

This study of bird migration is based upon the comparison of measured populations at many localities over a large part of the range of the species and covering all seasons of the year, rather than on first arrivals and latest departures as has been the custom. The population data consist of daily counts of individual robins (*Turdus migratorius*) observed on the same areas throughout the season. In order to supplement personal observations at one locality, the cooperation of approximately two hundred bird observers scattered over the country was obtained for the five years, 1937 to 1941, inclusive. The data were smoothed by plotting successive 7-day averages, in order to find the numerical trends in population, and correlated with temperature data smoothed in the same manner.

The population data for the areas censused by the writer at Urbana, Illinois, in 1940 and 1941, were supplemented by daily maps showing the position of all robins, the direction and extent of the longer flights, and the location of nests. Special symbols were used to indicate sex and age and marginal notes were made on behavior.

The accuracy to be expected in sexing robins by plumage characters alone was shown experimentally to be 80%; dorsal characters such as blackness of the head were found to be slightly more reliable than ventral characters such as breast color. This degree of accuracy, when supplemented by well-known behavior differences (only the males sing; only the females build, incubate, or brood), was considered sufficient for use in distinguishing the sexes in the field on a quantitative basis.

Resident robins arrive in proportion to the number of migrants passing through an area. When more than one peak occurred in the population of robins passing through an area, the proportion of the total population in each peak which remained as residents varied from zero to 100%. The proportion of migrants which remained as residents in an area was high in good breeding habitats such as city parks but very low in poor breeding habitats such as prairie.

Population-time curves for migrants passing through a locality are statistically the same as probability curves, while for residents they are integrated probability curves. Therefore, variations in the time of response to the migratory urge as well as in the urge to become nonmigratory follow the laws of probability.

South of latitude 45°N the peak population of male robins arrives in spring before the peak population of females, but considerable overlapping occurs (46% overlap at Urbana in 1941). North of 45°N the earliest

males tend to arrive before the earliest females, but the peak populations of the two sexes occur at the same time. In no instance was a female found to occur on a given territory before the male, although infrequently they arrived on the same day.

The beginning of the nonmigratory phase with the first establishment of territories is correlated with temperature, occurring several weeks earlier in warm years than in cold ones. The nonmigratory phase commences much earlier in the south than in the north; an extreme variation of four months is indicated. Nest-building was 17 days later in 1940 (a cool spring) than in 1941 (a warm spring). The beginning of nest-building occurs when the temperature trend reaches 48° F.

The observed changes in population during the nonmigratory phase were correlated with life-history stages by the use of line graphs. Decreases in the observed population were correlated with peak dates for incubating females. Postbreeding shifts of both adults and young after each brood were correlated in some cases with population increases, in other cases with decreases. Rising populations were shown to be due to flying young and to the release of females from incubation. Evidence is presented, based on population data, to show that generally the robin raises two and occasionally three broods from Rosedale, Mississippi, in the south to French River, Minnesota, in the north.

Robin movements during the nonmigratory phase were confined mostly to an area within 150 yards of the nest.

The majority of robins entered the roosts before sunset on cloudy nights and after sunset on clear nights. Direct measurements showed that robins respond to light intensities much less than one foot-candle. Population-time curves, showing the individual variations in time of roosting, are probability curves and are thus comparable to curves illustrating migratory movements. Loud choruses of robin song occur before each evening flight to the roost and after each morning flight from the roost during the nonmigratory phase. The light intensity of the full moon approximates the value at which some robins normally leave the roost in the morning and disturbs the roosting routine. A late summer roost was composed almost entirely of young robins. Further evidence is presented to show that robins fly to the roosts from distances greater than one mile; very young robins and incubating or brooding females do not use the roost; some roosts are used throughout the season while others are used only during the migratory phase; some roosts are used for several years, although others are used for only a few days; and that robin roosts are widely distributed throughout the range of the species.

A vector method for finding directional trends from banding and observational data has been presented. Both adult and young robins tend

to shift in a northerly direction in the postbreeding period, or toward regions of lower temperature and more surface water. Postbreeding movements of robins occasionally involve distances of one hundred miles. Population data have indicated that young robins usually leave the territory of their parents within a week after leaving the nest; only one case was noted where an adult drove a young robin from its territory.

Isochronal lines based upon dates of population peaks have been presented for both autumn and spring migrations. Robins showed a marked tendency to delay their autumn departure from localities with an abundant crop of such persistent wild fruits as mountain ash, certain haws, and wild crab apples.

The "normal" southward trend in the autumn is reversed during periods of high or sharply rising temperatures, and the northward trend in spring is reversed during periods of low or falling temperatures. There is great individual variation in the response of robins to factors causing migration.

Robins avoid large bodies of water such as the Great Lakes and the Atlantic Ocean during migration. They show a tendency to fly parallel to certain ridges of low mountains, while large river valleys apparently exert little or no influence on the direction of migration. Robins tend to avoid prairie regions during the colder periods of the migratory phase.

Robins which occur in a particular locality in summer migrate at various times and are found scattered over wide areas during the winter. The average rate of southward movement, based upon population peaks at various localities in 1939 and 1940, was 18 miles per day. The actual rate of southward movement varied widely from the average and was at times temporarily reversed.

During the winter robin populations shift northward and southward with changes in temperature and food supply. Robin population peaks occur mainly at temperatures between 40° F. and 60° F. during the migratory phase, with the greatest frequency at 50° F. Banding evidence also indicates that 94% winter between the 40° F. and 60° F. isotherms.

Robins are most abundant in winter in the pine and oak-pine associes of the deciduous forest biome. Some robins occur in the north during the winter in islands of relatively optimum habitat. Male and female, young and adult, robins winter in the same general region; however, from central Georgia to northern Louisiana the males show a tendency to winter north of the females, and the young show a similar tendency to winter north of the adults. Robins breeding in the east tend to winter farther east than robins breeding in the west, but overlapping occurs. Most northern robins winter in the same latitudes as robins raised in the south.

Very cold weather in the southern states in the winter causes mortality by reducing the quantity of available insect food. Such winter mortality is reflected in reduced breeding populations in the north the following year.

Southward movement of robins is stimulated by low or rapidly falling temperatures, by the search for better food conditions, by ice and snow cover, and by the search for suitable roosting cover. Northward movement of robins is stimulated by high or rising temperatures and by the search for suitable nesting niches.

Robins exhibit two opposing types of behavior during the year, as has been described for other species. These have been designated in this thesis as the "migratory phase" and the "nonmigratory phase." The nonmigratory phase is limited to the breeding season when robin movements are greatly restricted and there is isolation of pairs on nesting territories. The migratory phase is exhibited in some degree throughout the year. It is characterized by the tendency for the birds to form aggregations and to respond quickly to changing conditions of weather and food supply by repeated northward and southward shifts. The daily migration to and from the roost during the breeding season is a manifestation of this type of behavior, and the occasional longer daytime flights of individual robins out of their territories indicate a temporary overriding of the nonmigratory behavior by the migratory type. This concept differs from the prevailing theory that migration is a movement between two fixed areas, released by specific hormones during limited periods in spring and autumn.

VITA

John Murray Speirs was born at Toronto, Ontario, Canada, April 7, 1909. He attended Withrow Public School and the University of Toronto Schools, matriculating in 1926. In 1927, and from 1929 to 1931, he was a student at the University of Toronto, receiving the B.A. degree in 1931. He attended the Ontario College of Education in 1932 and took further special work there in 1935. In 1931 and in 1934 he was a demonstrator in astronomy at the University of Toronto. From 1936 to 1938 he was a graduate student and demonstrator in zoology at the University of Toronto, and held the Ramsay Wright Scholarship in the latter year. From 1931 to 1938 he was a part-time teacher in technical and high schools in Ontario and carried on part-time research at the Royal Ontario Museum of Zoology in Toronto. From 1939 to 1941, and in 1946, he was a graduate student and assistant in zoology at the University of Illinois. He spent part of the summer of 1939 at the Hopkins Marine Station, Pacific Grove, California. During the war he was a meteorologist attached to an R.A.F. station in northern Ontario. He is a member of Sigma Xi and Phi Sigma.

A list of Mr. Speirs' scientific papers is as follows:

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